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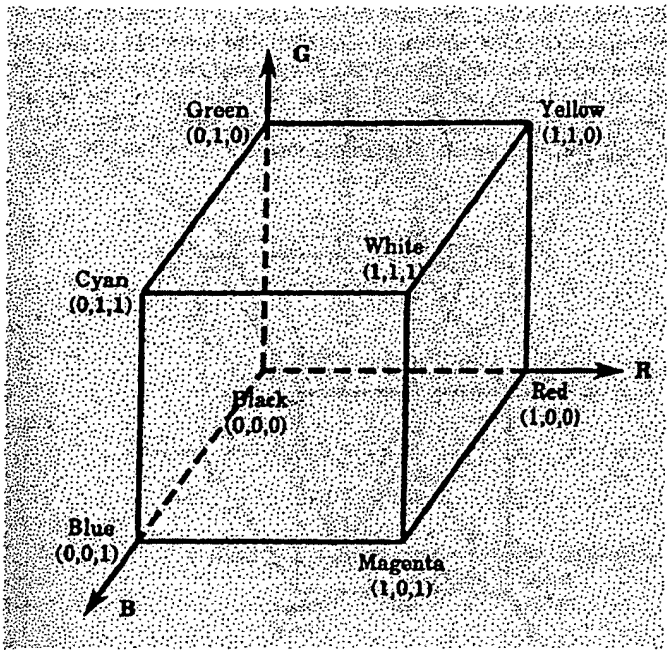
G
Green
(0,1,0)
Yellow
(1,1,0)
White
(1,1,1)
Cyan
(0,1,1)
R
Red
(1,0,0)
Black
(0,0,0)
Blue
(0,0,1)
Magenta
(1,0,1)
B

FIG. 1

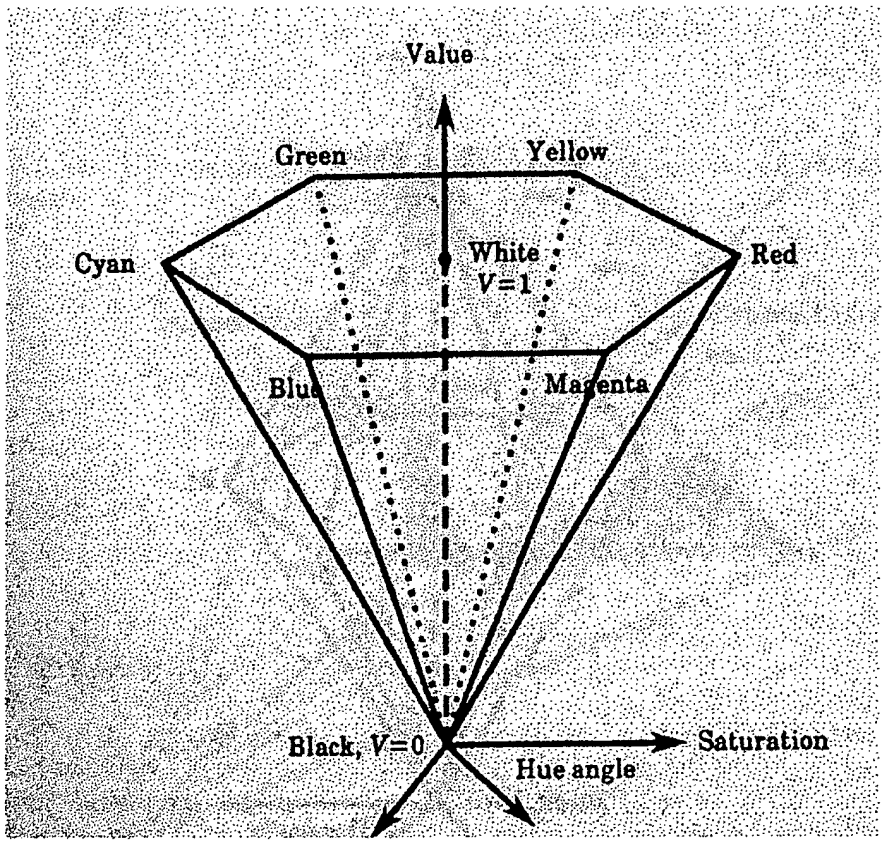
Value
Green
Yellow
Cyan
White
V=1
Red
Blue
Magenta
Black, V=0
Saturation
Hue angle

FIG. 2

Diagram of Video Connections

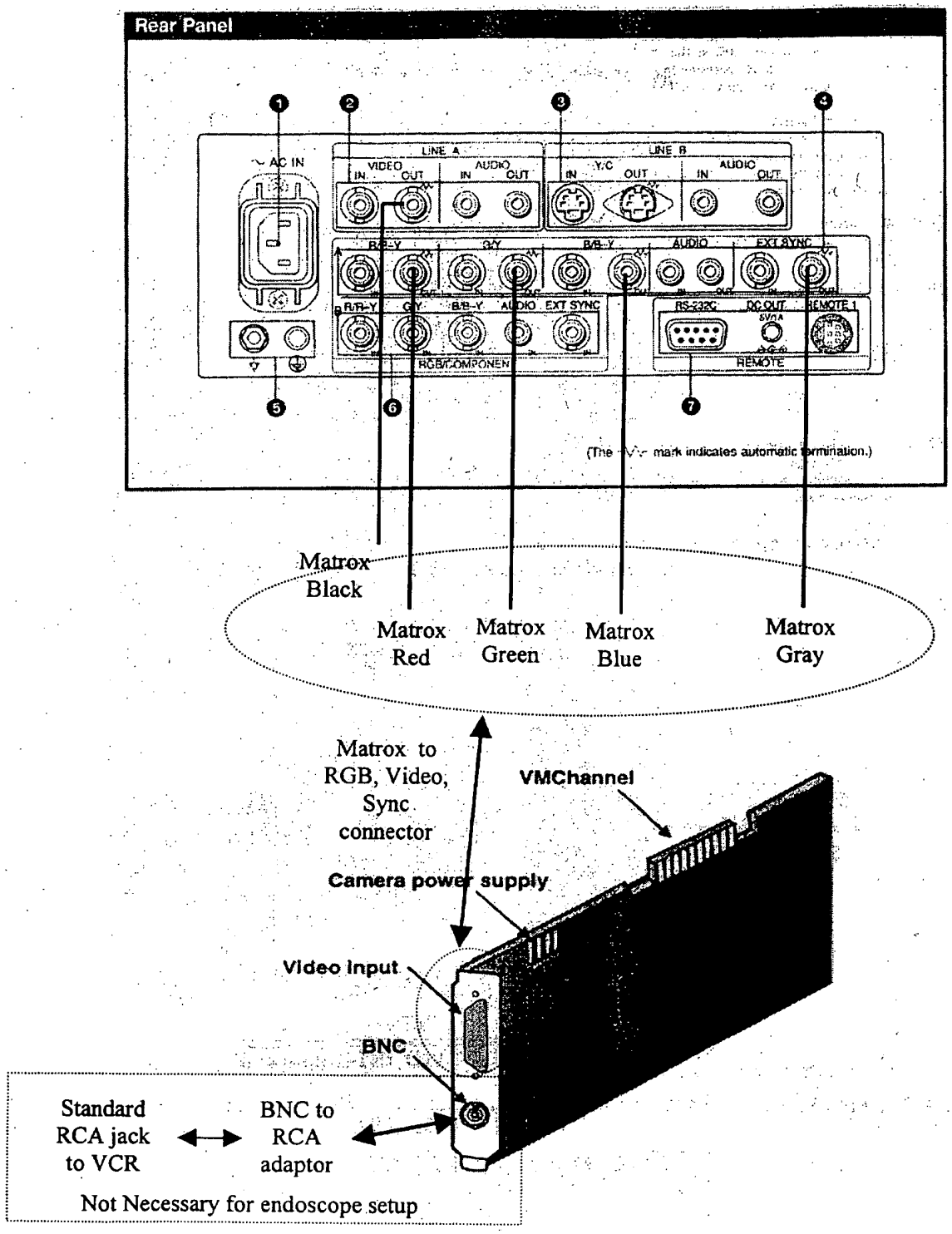

FIG. 3

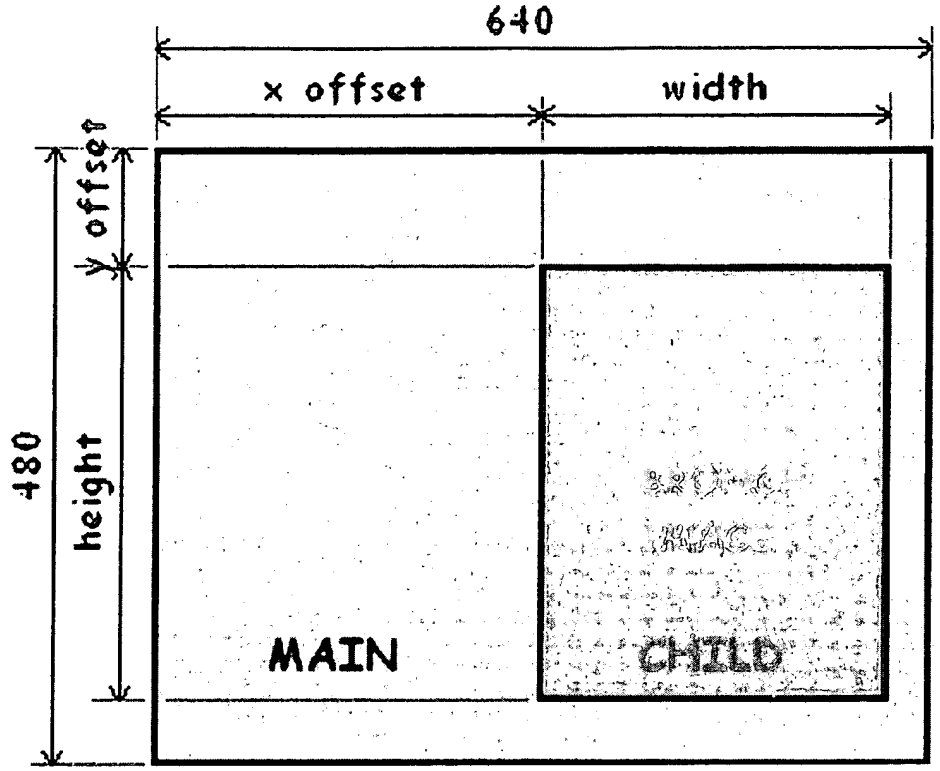

FIG. 4

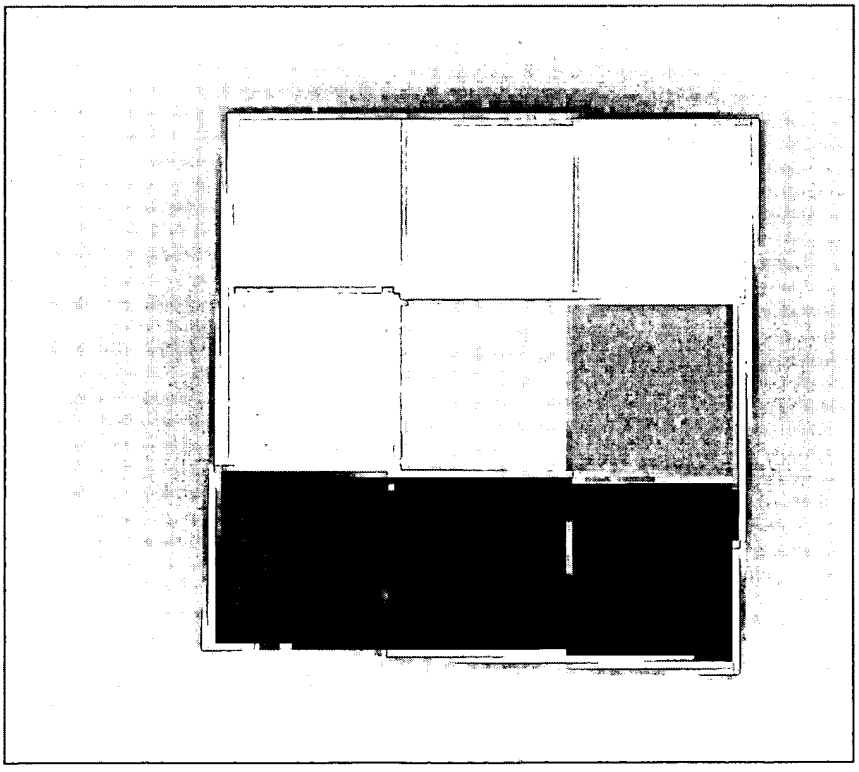

FIG. 5

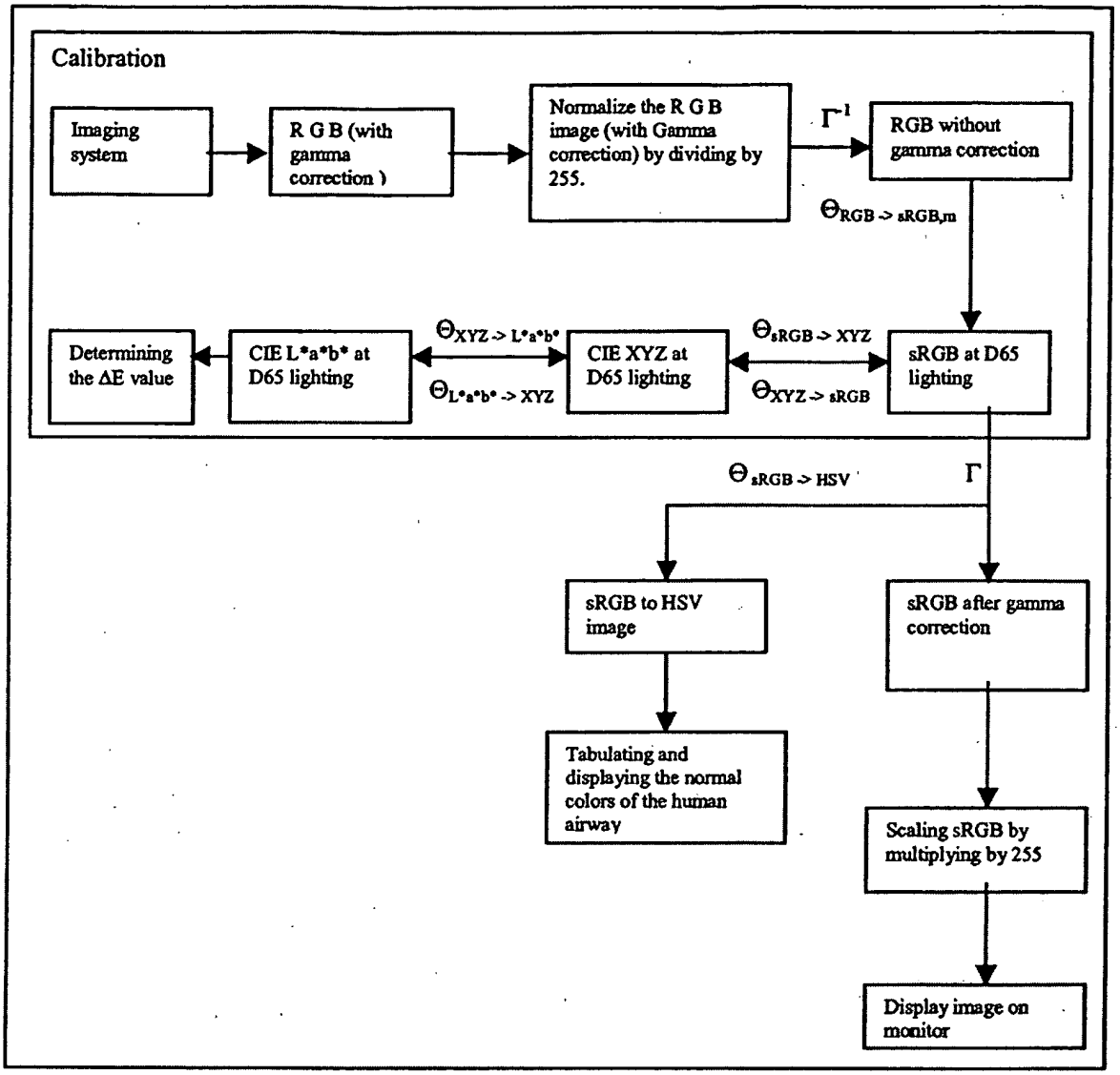
Calibration
Imaging system
R G B (with gamma correction)
Normalize the R G B image (with Gamma correction) by dividing by 255.
Γ-1
RGB without gamma correction
ΘRGB -> sRGB,m
Determining the ΔE value
CIE L*a*b* at D65 lighting
ΘXYZ -> L*a*b*
ΘL*a*b* -> XYZ
CIE XYZ at D65 lighting
ΘsRGB -> XYZ
ΘXYZ -> sRGB
sRGB at D65 lighting
ΘsRGB -> HSV
Γ
sRGB to HSV image
sRGB after gamma correction
Tabulating and displaying the normal colors of the human airway
Scaling sRGB by multiplying by 255
Display image on monitor

FIG. 6

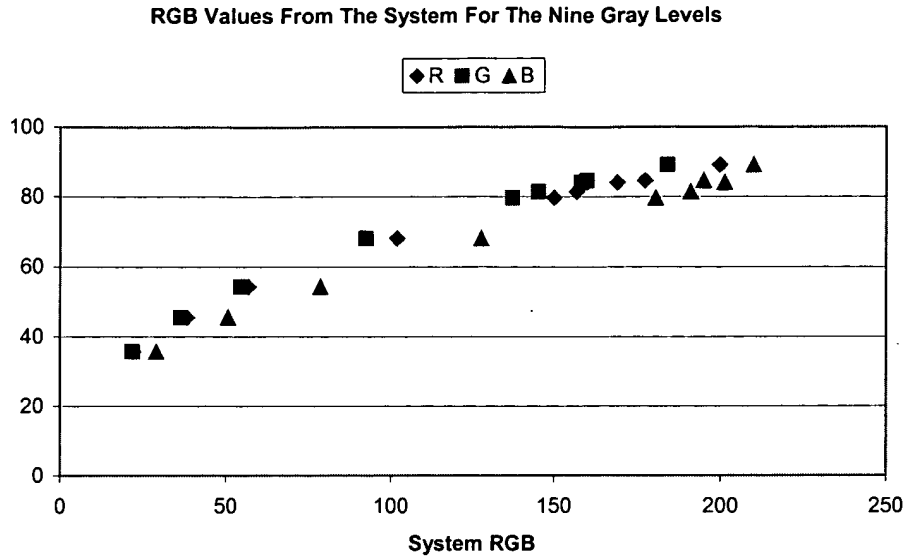
RGB Values From The System For The Nine Gray Levels
◆R ■G ▲B
100
80
60
40
20
0
0
50
100
150
200
250
System RGB

FIG. 7A

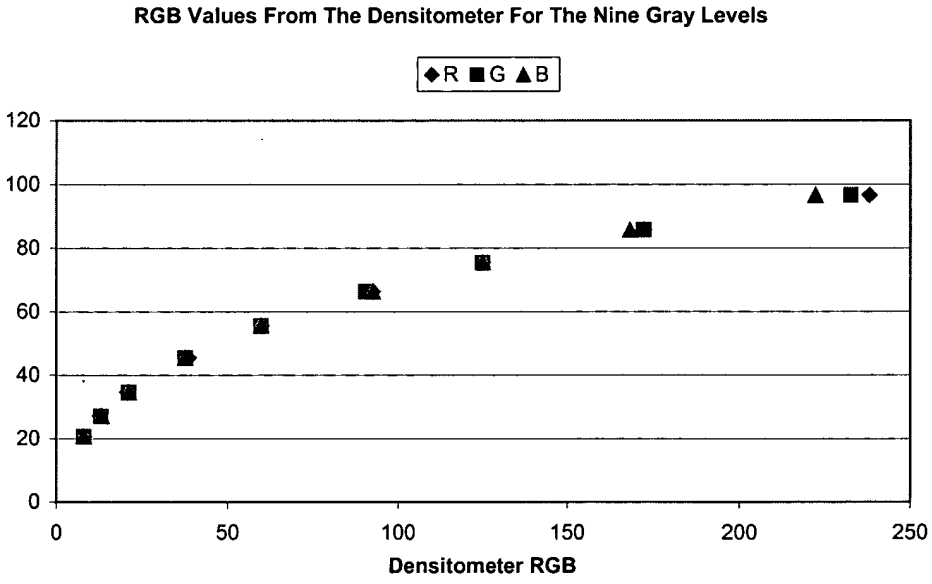
RGB Values From The Densitometer For The Nine Gray Levels
◆R ■G ▲B
120
100
80
60
40
20
0
0
50
100
150
200
250
Densitometer RGB

FIG. 7B

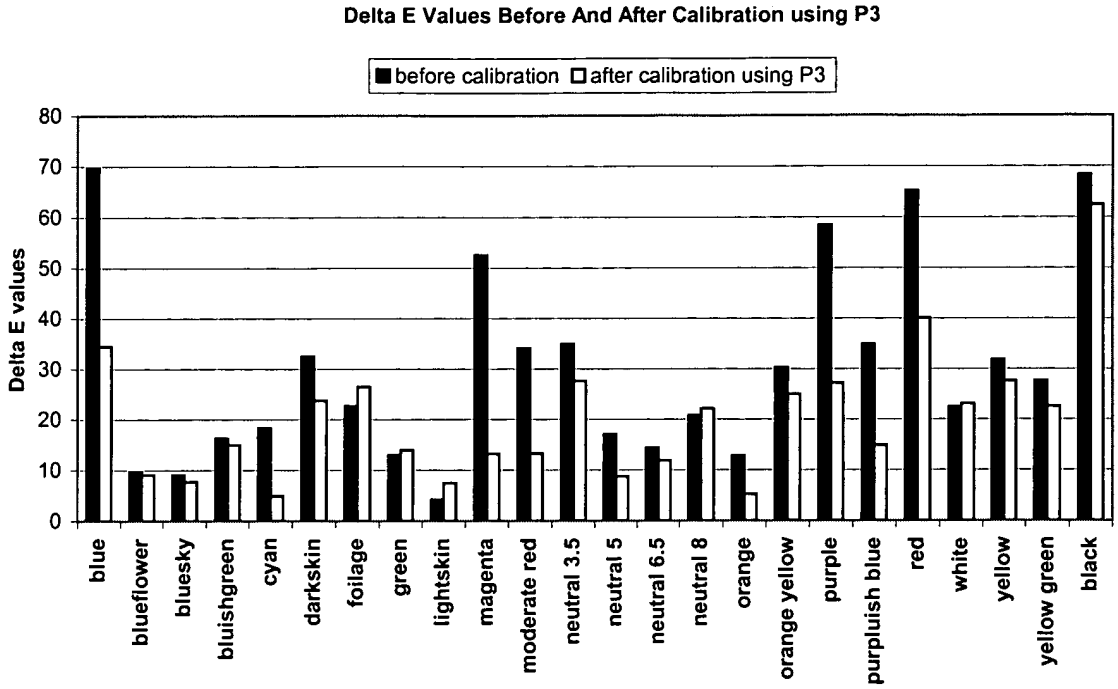
Delta E Values Before And After Calibration using P3
before calibration
after calibration using P3
Delta E values
0
10
20
30
40
50
60
70
80
blue
blueflower
bluesky
bluishgreen
cyan
darkskin
foilage
green
lightskin
magenta
moderate red
neutral 3.5
neutral 5
neutral 6.5
neutral 8
orange
orange yellow
purple
purpluish blue
red
white
yellow
yellow green
black

FIG. 8

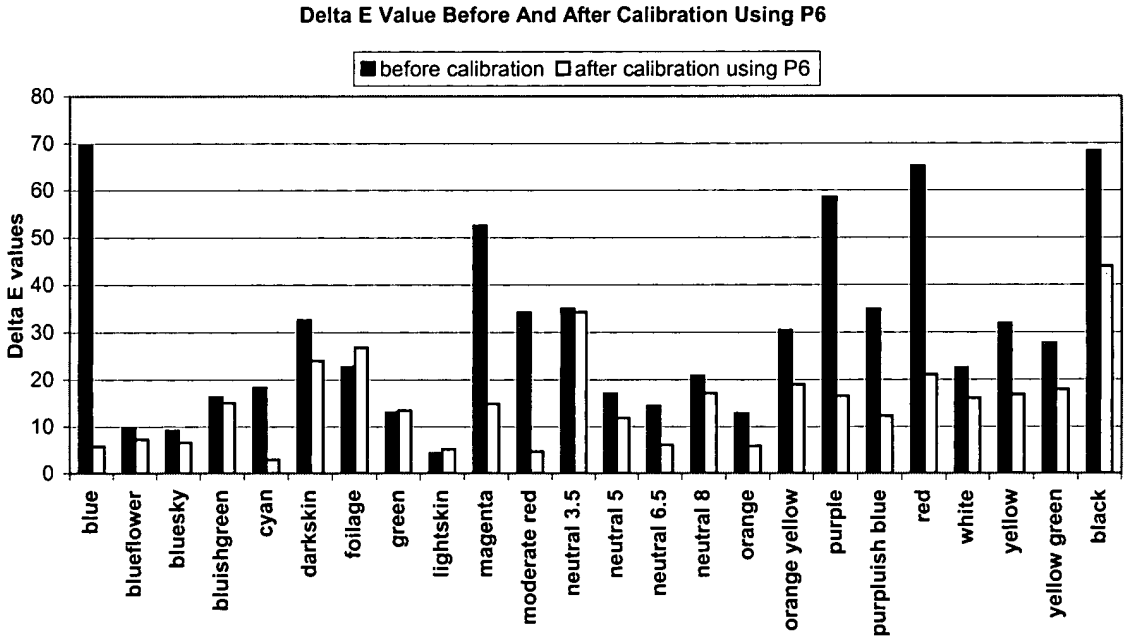
Delta E Value Before And After Calibration Using P6
before calibration
after calibration using P6
Delta E values
0
10
20
30
40
50
60
70
80
blue
blueflower
bluesky
bluishgreen
cyan
darkskin
foilage
green
lightskin
magenta
moderate red
neutral 3.5
neutral 5
neutral 6.5
neutral 8
orange
orange yellow
purple
purpluish blue
red
white
yellow
yellow green
black

FIG. 9

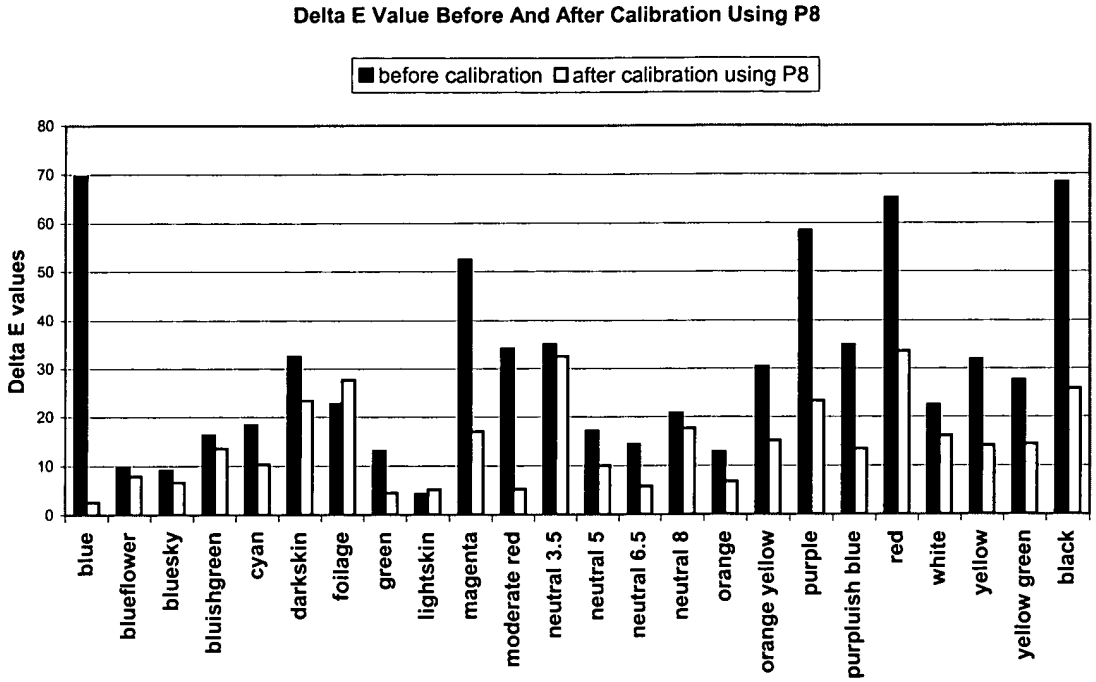
Delta E Value Before And After Calibration Using P8
before calibration
after calibration using P8
Delta E values
0
10
20
30
40
50
60
70
80
blue
blueflower
bluesky
bluishgreen
cyan
darkskin
foilage
green
lightskin
magenta
moderate red
neutral 3.5
neutral 5
neutral 6.5
neutral 8
orange
orange yellow
purple
purpluish blue
red
white
yellow
yellow green
black

FIG. 10

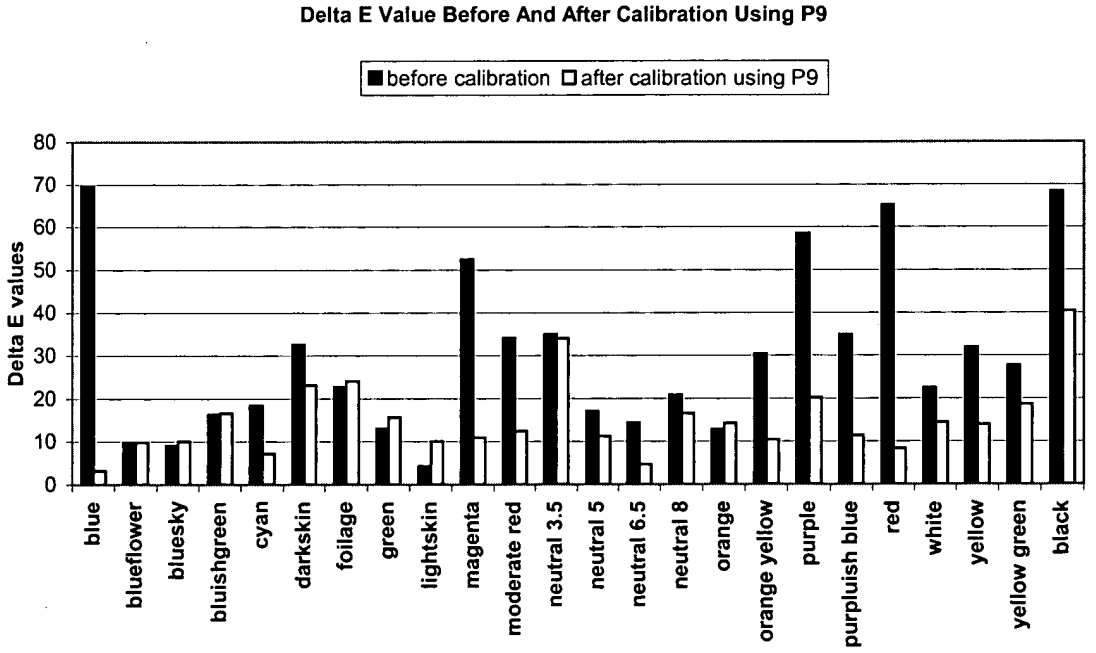
Delta E Value Before And After Calibration Using P9
before calibration
after calibration using P9
Delta E values
0
10
20
30
40
50
60
70
80
blue
blueflower
bluesky
bluishgreen
cyan
darkskin
foilage
green
lightskin
magenta
moderate red
neutral 3.5
neutral 5
neutral 6.5
neutral 8
orange
orange yellow
purple
purpluish blue
red
white
yellow
yellow green
black

FIG. 11

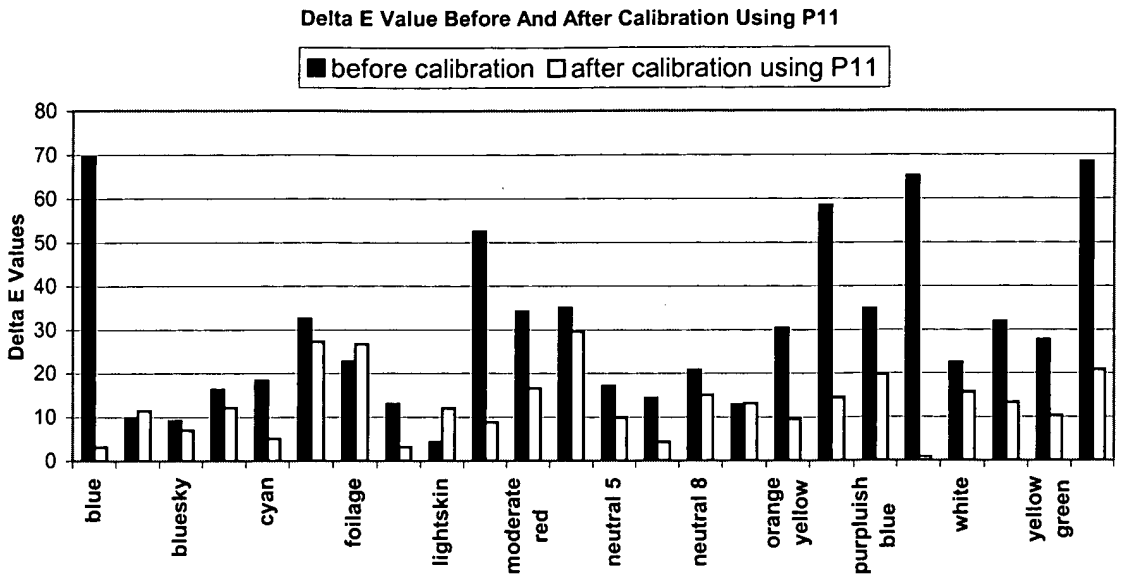
Delta E Value Before And After Calibration Using P11
before calibration
after calibration using P11
Delta E Values
80
70
60
50
40
30
20
10
0
blue
bluesky
cyan
foilage
lightskin
moderate red
neutral 5
neutral 8
orange yellow
purpluish blue
white
yellow green

FIG. 12

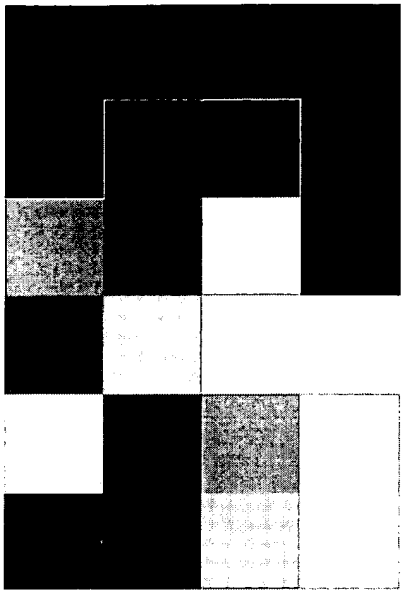

FIG. 13A

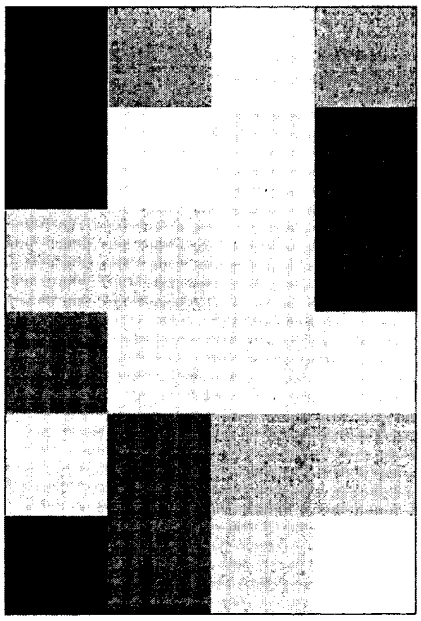

FIG. 13B

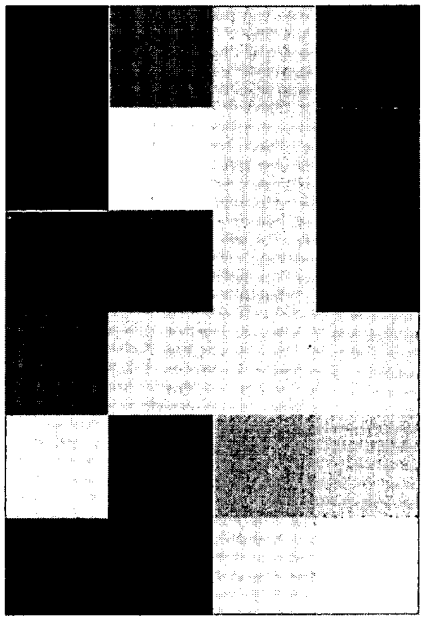

FIG. 13C

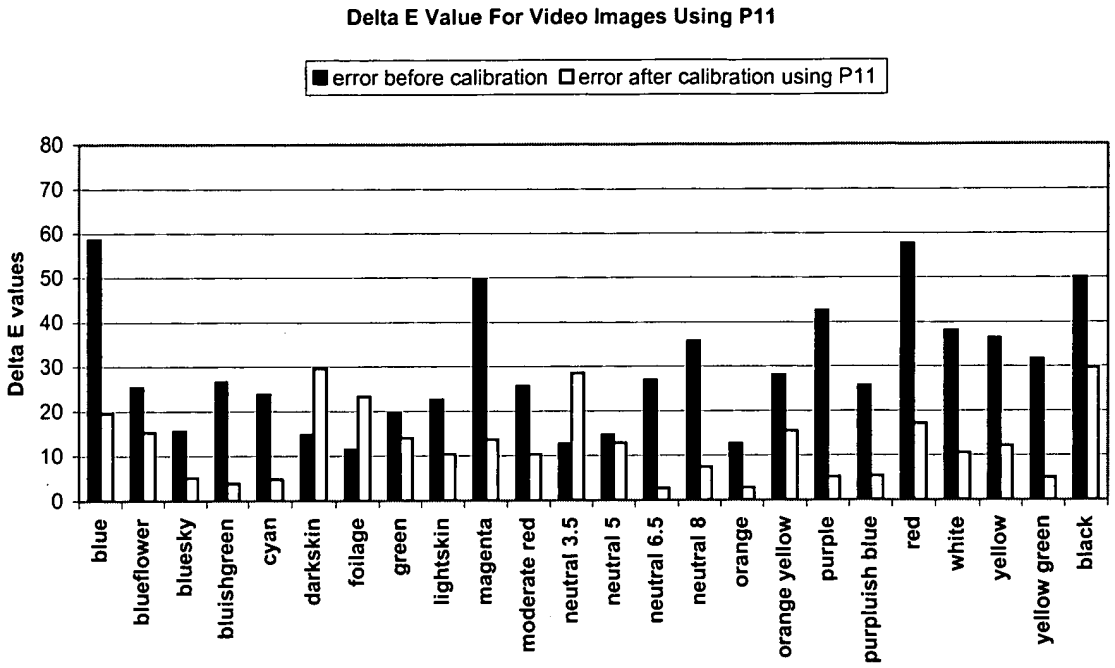
Delta E Value For Video Images Using P11
error before calibration
error after calibration using P11
Delta E values
80
70
60
50
40
30
20
10
0
blue
blueflower
bluesky
bluishgreen
cyan
darkskin
foilage
green
lightskin
magenta
moderate red
neutral 3.5
neutral 5
neutral 6.5
neutral 8
orange
orange yellow
purple
purpluish blue
red
white
yellow
yellow green
black

FIG. 14

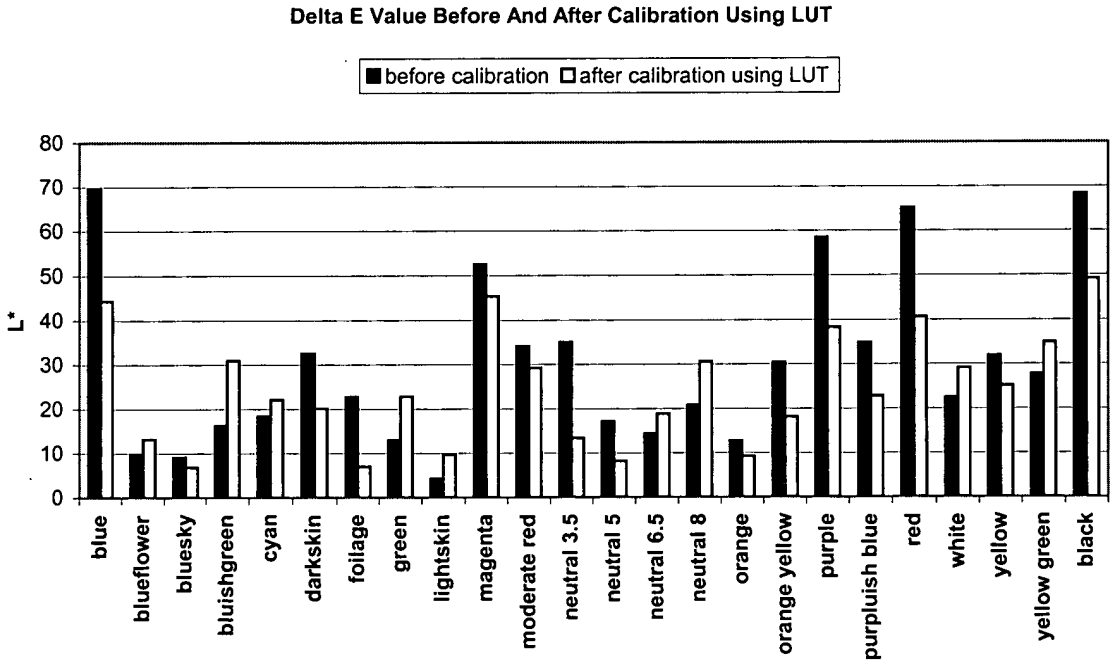
Delta E Value Before And After Calibration Using LUT
before calibration
after calibration using LUT
L*
80
70
60
50
40
30
20
10
0
blue
blueflower
bluesky
bluishgreen
cyan
darkskin
foilage
green
lightskin
magenta
moderate red
neutral 3.5
neutral 5
neutral 6.5
neutral 8
orange
orange yellow
purple
purpluish blue
red
white
yellow
yellow green
black

FIG. 15

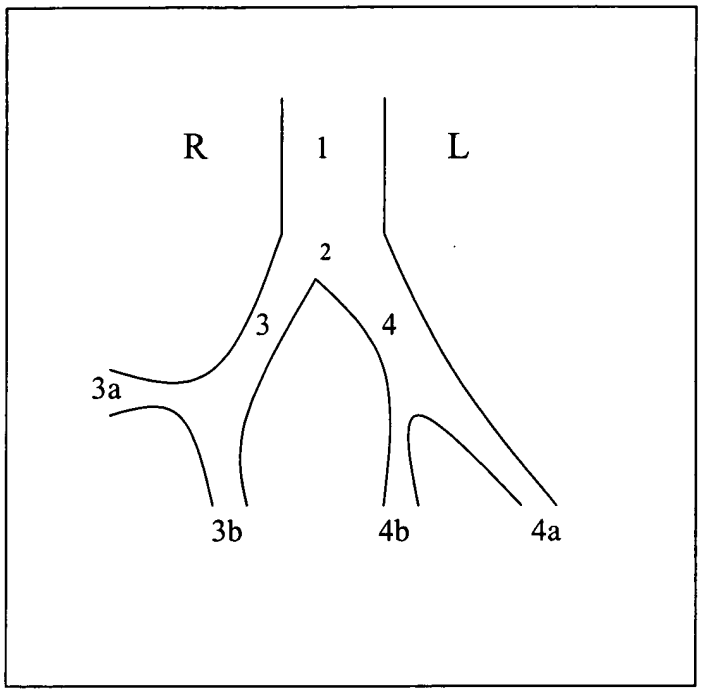

FIG. 16

FIG. 17A

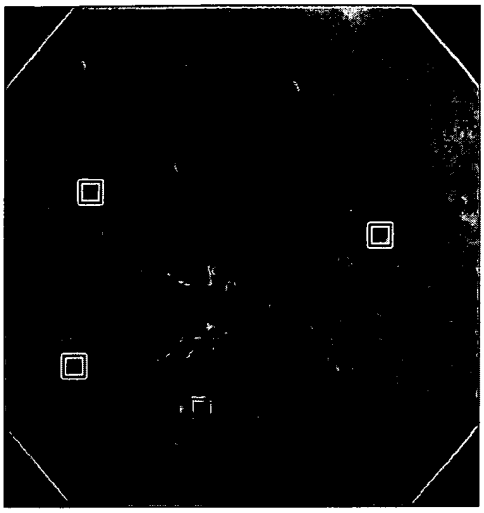

FIG. 17B

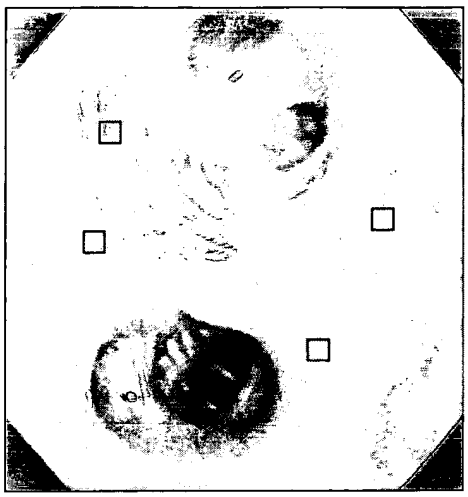

FIG. 17C

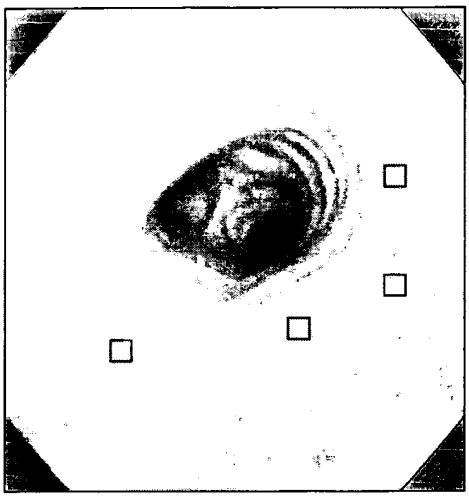

FIG. 17D

FIG. 18

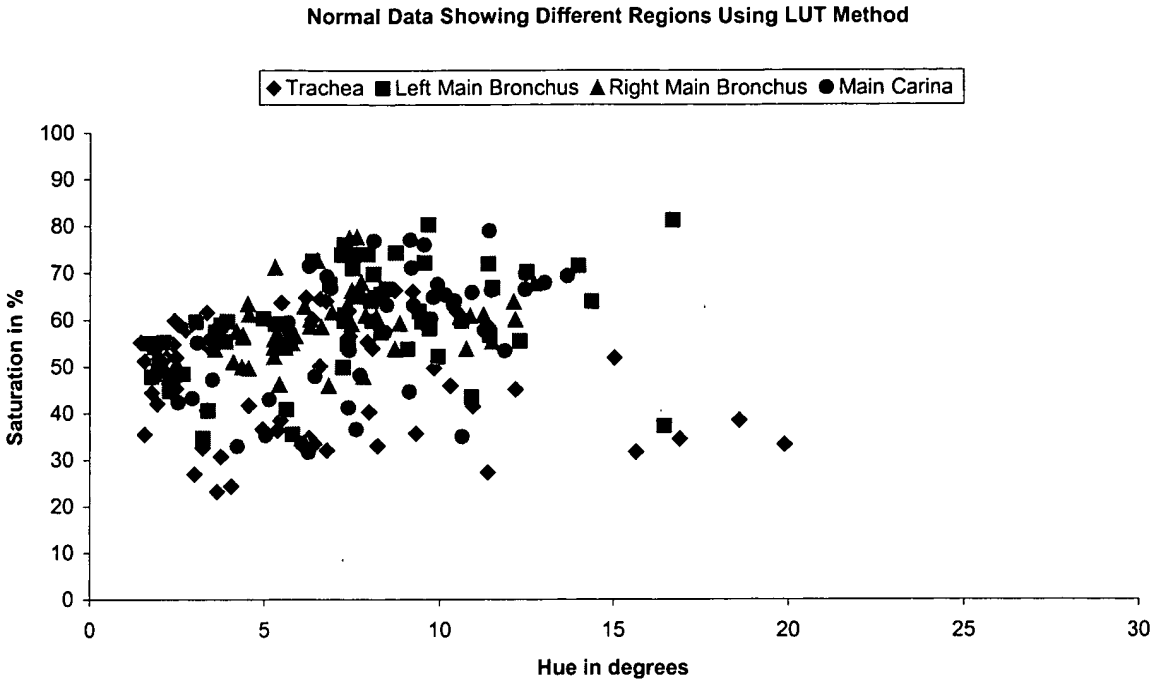
Normal Data Showing Different Regions Using LUT Method
◆Trachea ■Left Main Bronchus ▲Right Main Bronchus ●Main Carina
Saturation in %
100
90
80
70
60
50
40
30
20
10
0
0
5
10
15
20
25
30
Hue in degrees

FIG. 19

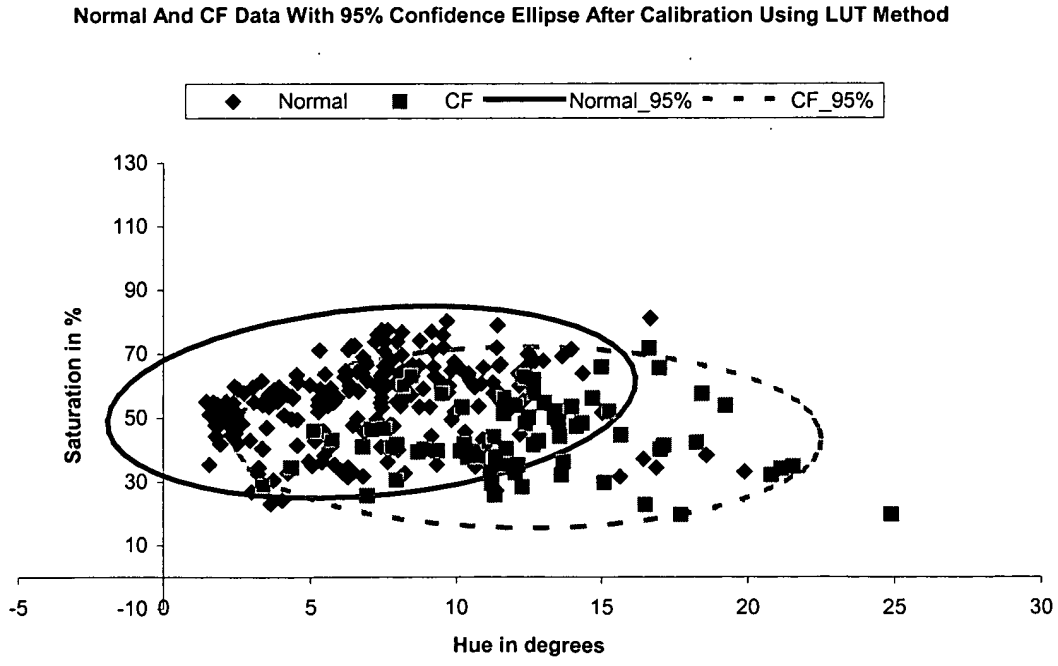
Normal And CF Data With 95% Confidence Ellipse After Calibration Using LUT Method
◆ Normal ■ CF Normal_95% CF_95%
Saturation in %
130
110
90
70
50
30
10
-5
-10
0
5
10
15
20
25
30
Hue in degrees

FIG. 20

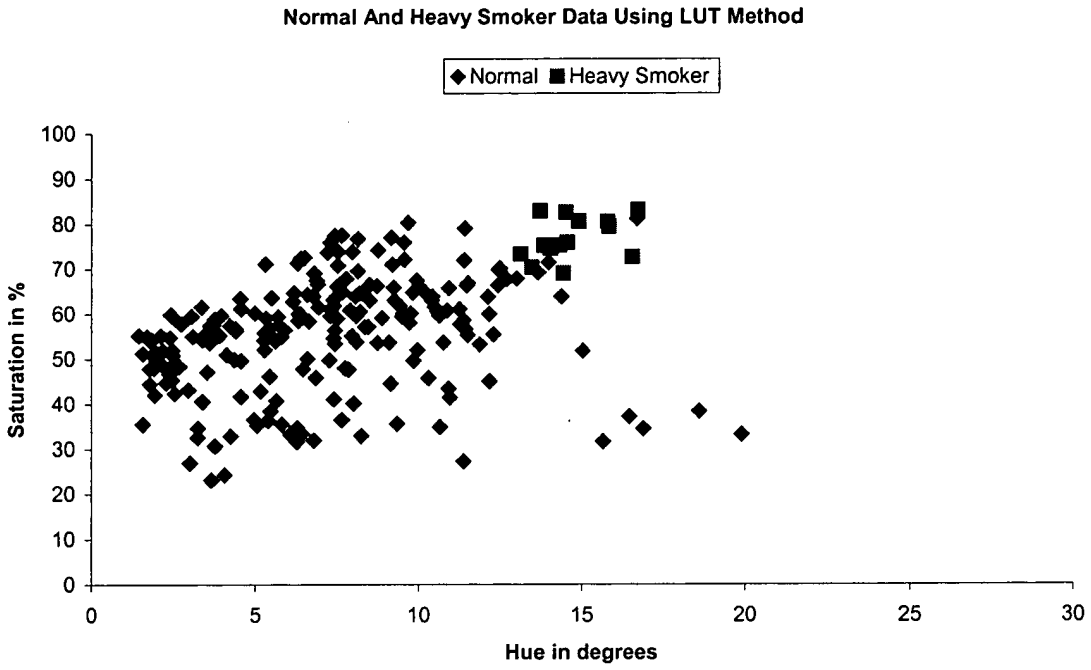
Normal And Heavy Smoker Data Using LUT Method
Normal
Heavy Smoker
Saturation in %
100
90
80
70
60
50
40
30
20
10
0
0
5
10
15
20
25
30
Hue in degrees

FIG. 21

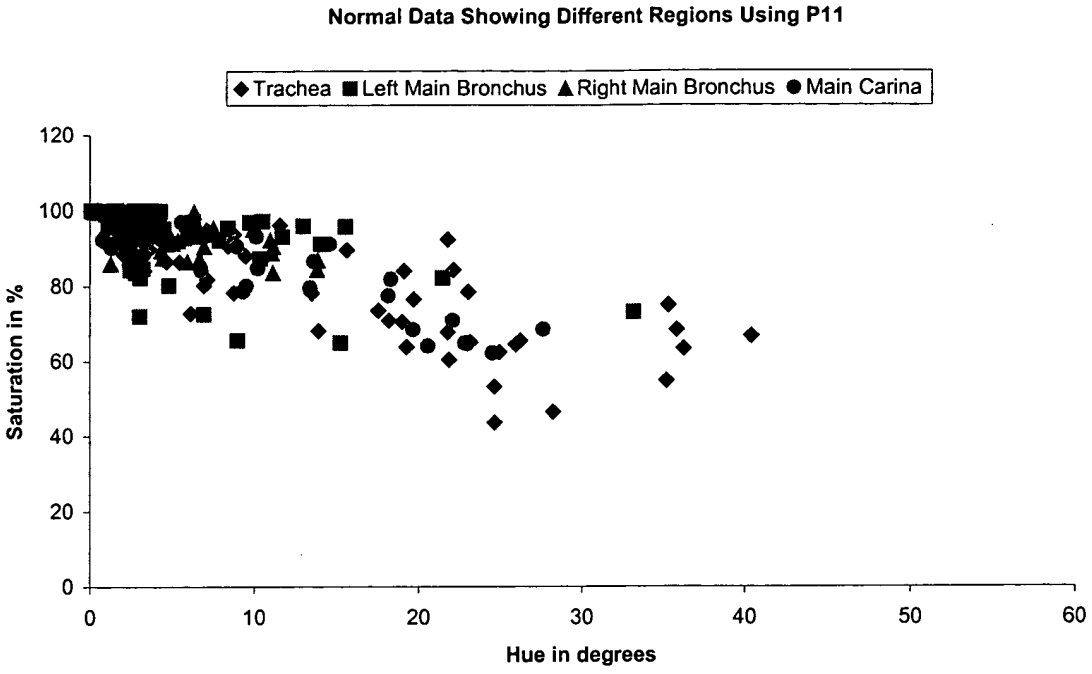
Normal Data Showing Different Regions Using P11
◆Trachea ■Left Main Bronchus ▲Right Main Bronchus ●Main Carina
Saturation in %
120
100
80
60
40
20
0
0
10
20
30
40
50
60
Hue in degrees

FIG. 22

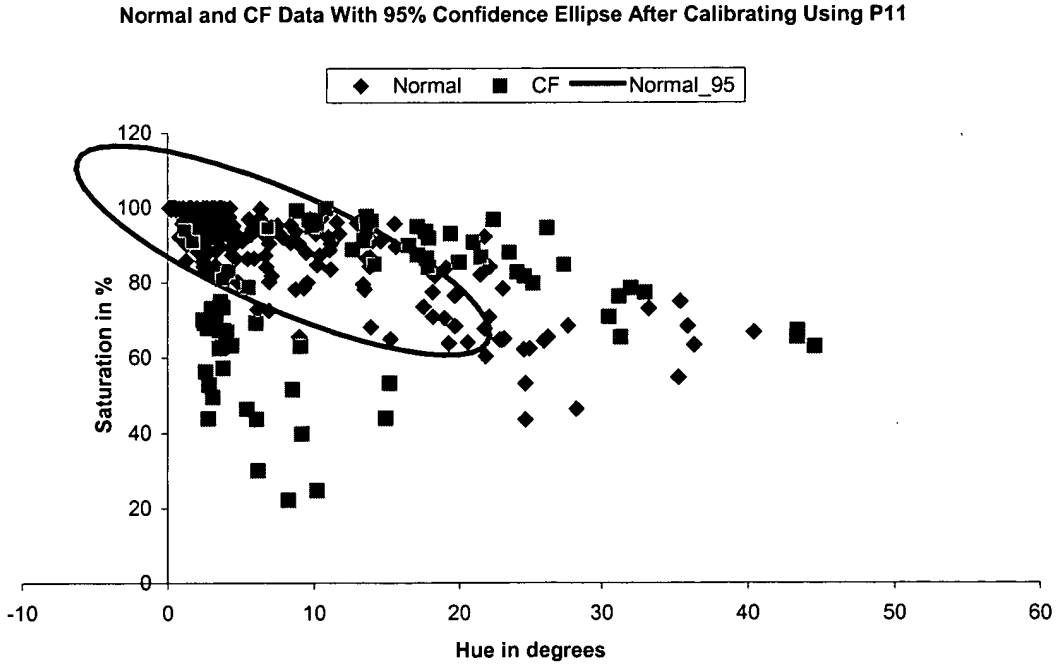
Normal and CF Data With 95% Confidence Ellipse After Calibrating Using P11
◆ Normal ■ CF Normal_95
Saturation in %
120
100
80
60
40
20
0
-10
0
10
20
30
40
50
60
Hue in degrees

FIG. 23

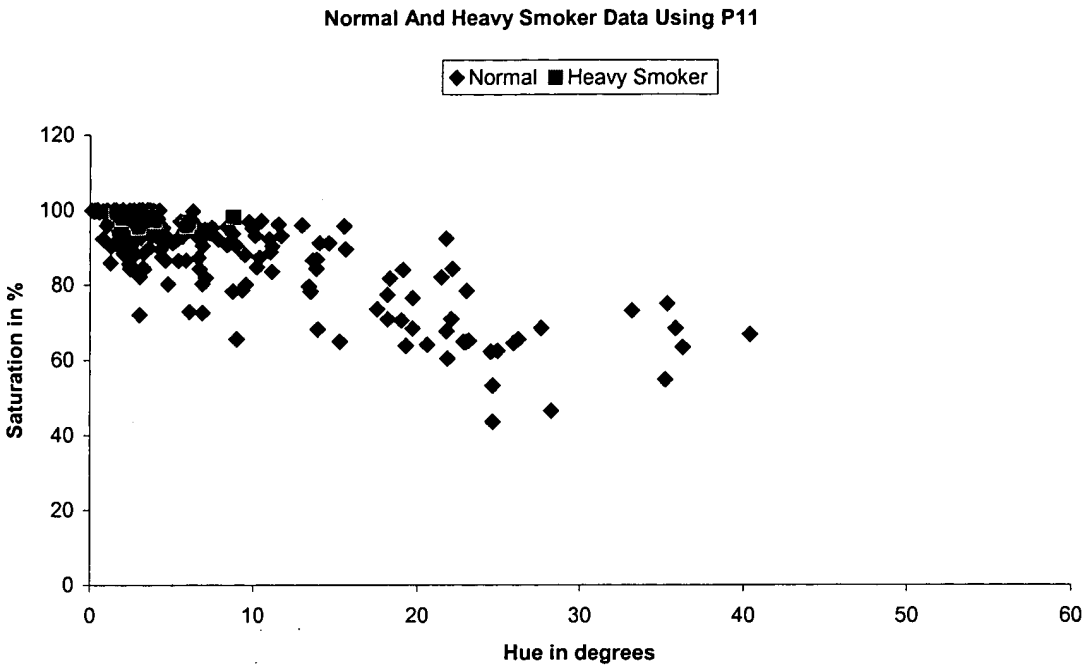
Normal And Heavy Smoker Data Using P11
Normal
Heavy Smoker
Saturation in %
120
100
80
60
40
20
0
0
10
20
30
40
50
60
Hue in degrees

FIG. 24

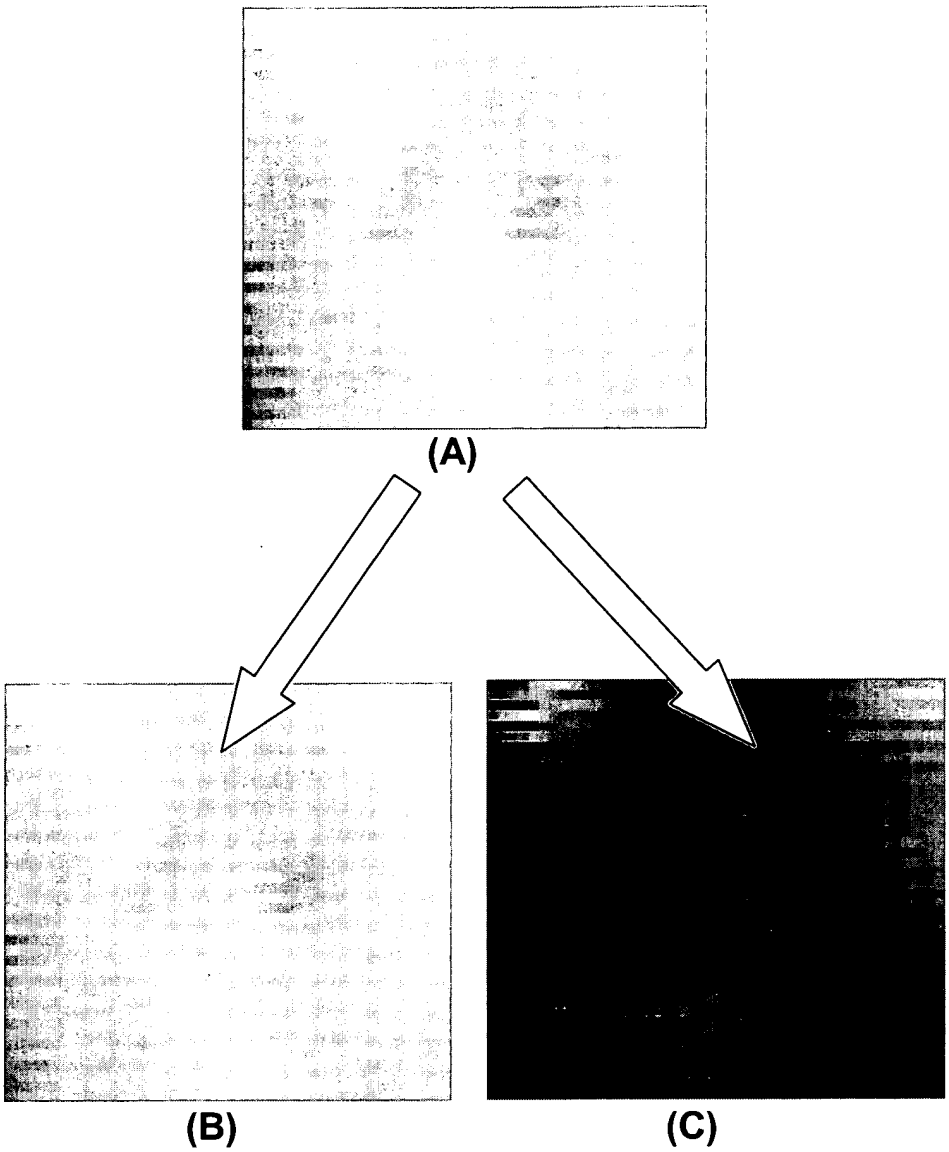

FIG. 25

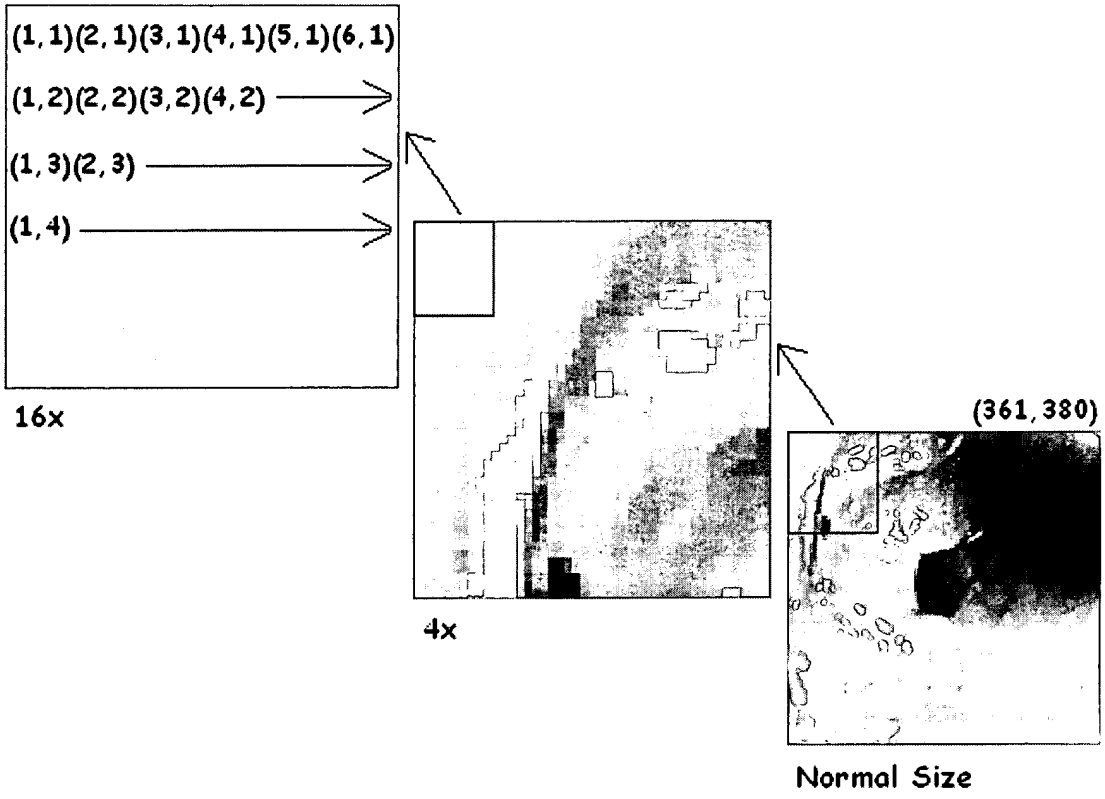
(1, 1)(2, 1)(3, 1)(4, 1)(5, 1)(6, 1)
(1, 2)(2, 2)(3, 2)(4, 2)
(1, 3)(2, 3)
(1, 4)
16x
4x
(361, 380)
Normal Size

FIG. 26

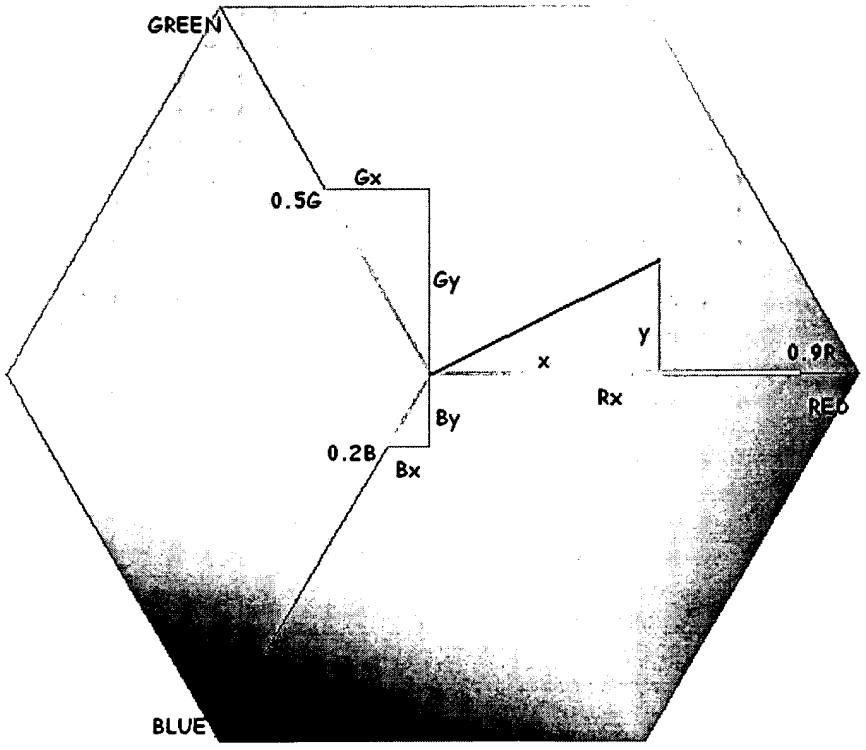
GREEN
Gx
0.5G
Gy
y
x
0.9R
Rx
RED
By
0.2B
Bx
BLUE

FIG. 27

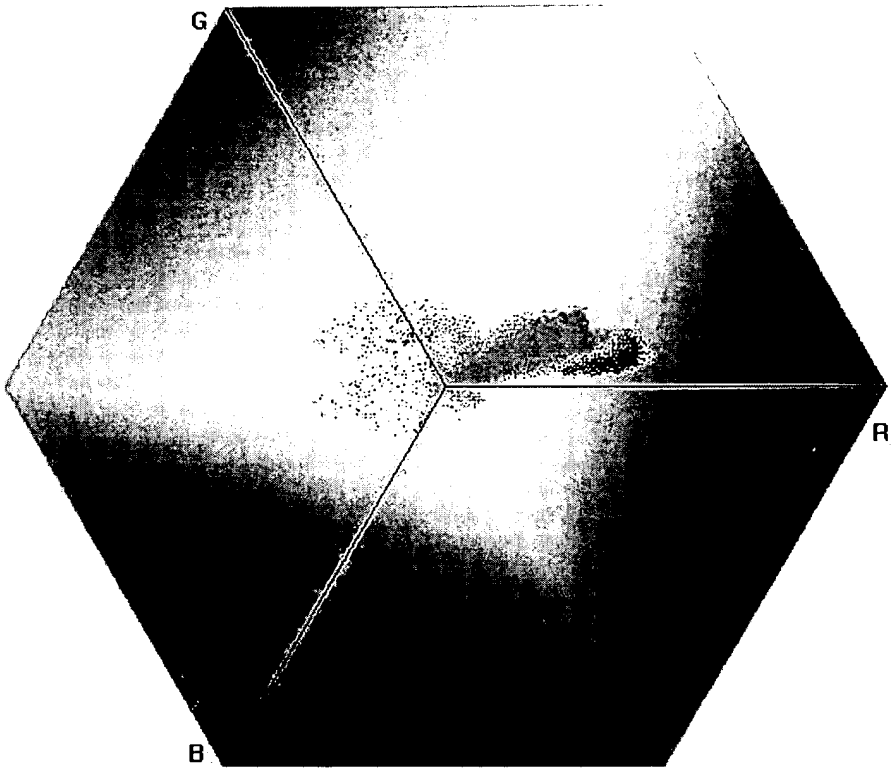

FIG. 28

FIG. 29

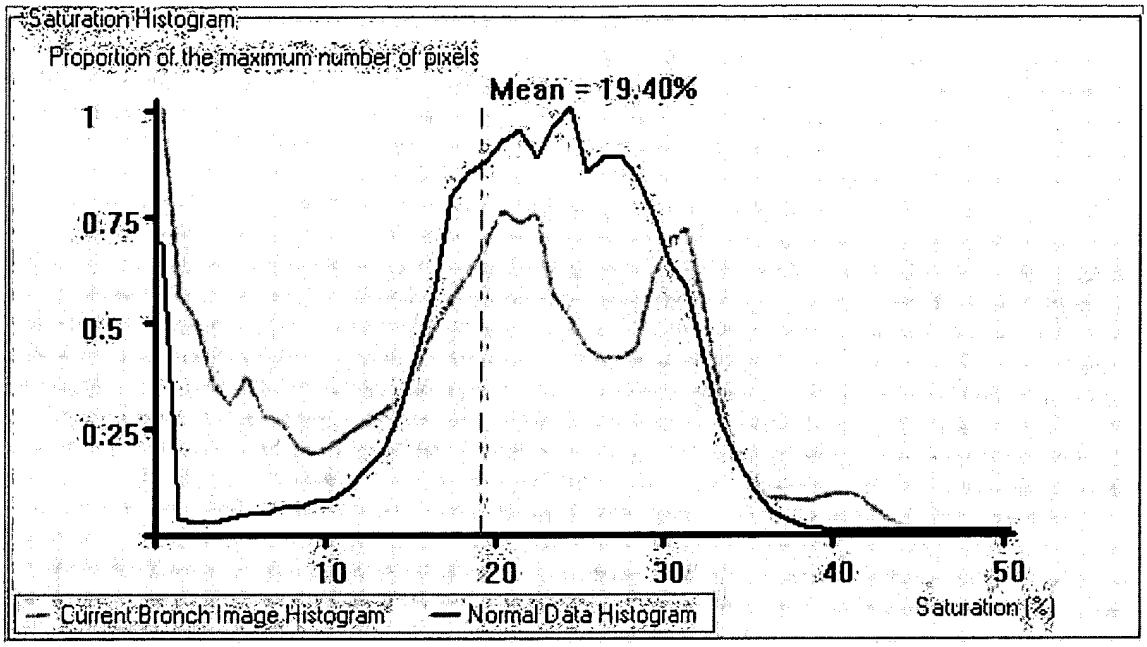
Saturation Histogram
Proportion of the maximum number of pixels
Mean = 19.40%
1
0.75
0.5
0.25
10
20
30
40
50
Saturation (%)
Current Bronch Image Histogram
Normal Data Histogram

FIG. 30

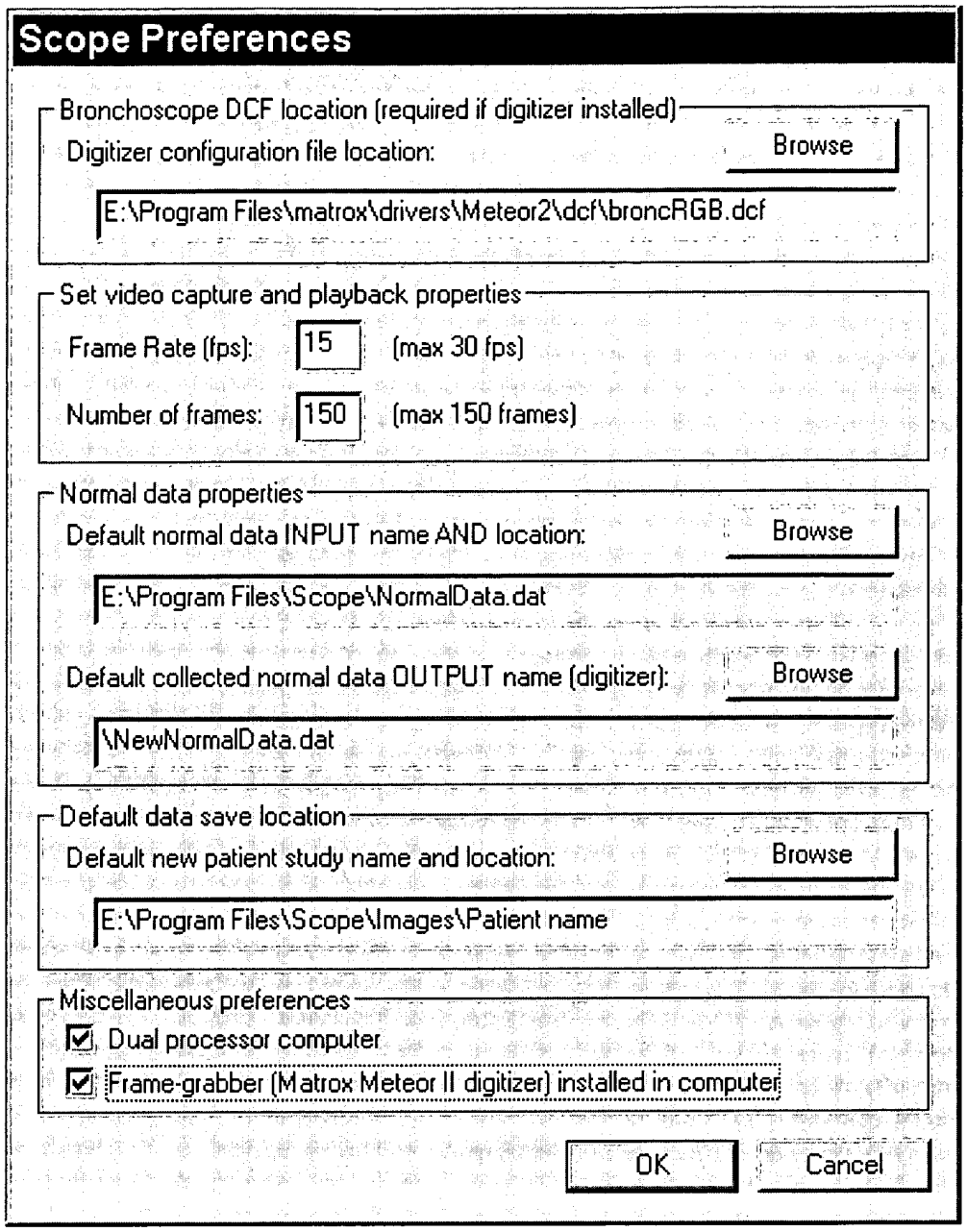
Scope Preferences
Bronchoscope DCF location (required if digitizer installed)
Digitizer configuration file location:
Browse
E:\Program Files\matrox\drivers\Meteor2\dcf\broncRGB.dcf
Set video capture and playback properties
Frame Rate (fps):
15
(max 30 fps)
Number of frames:
150
(max 150 frames)
Normal data properties
Default normal data INPUT name AND location:
Browse
E:\Program Files\Scope\NormalData.dat
Default collected normal data OUTPUT name (digitizer):
Browse
\NewNormalData.dat
Default data save location
Default new patient study name and location:
Browse
E:\Program Files\Scope\Images\Patient name
Miscellaneous preferences
Dual processor computer
Frame-grabber (Matrox Meteor II digitizer) installed in computer
OK
Cancel

FIG. 31

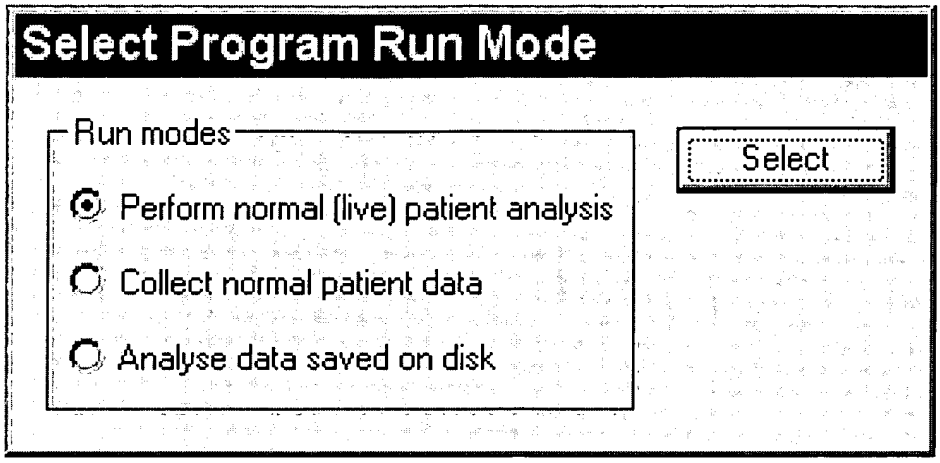
Select Program Run Mode
Run modes
Perform normal (live) patient analysis
Collect normal patient data
Analyse data saved on disk
Select

FIG. 32

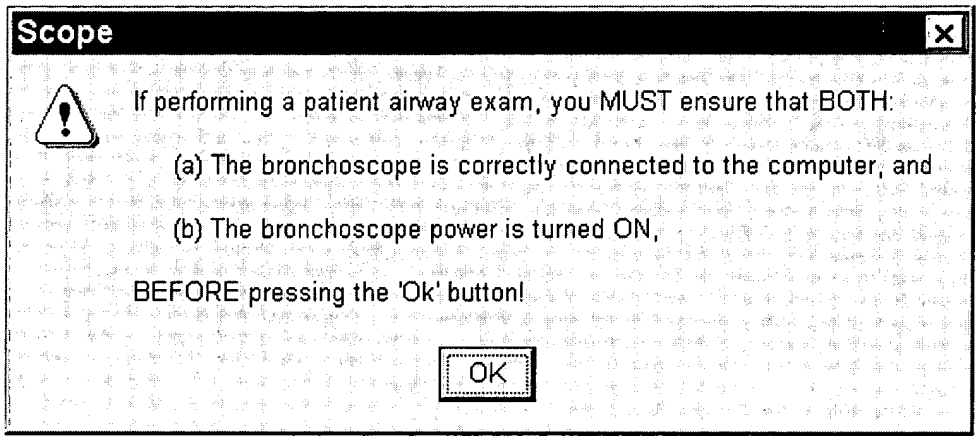
Scope
If performing a patient airway exam, you MUST ensure that BOTH:
(a) The bronchoscope is correctly connected to the computer, and
(b) The bronchoscope power is turned ON,
BEFORE pressing the 'Ok' button!
OK

FIG. 33

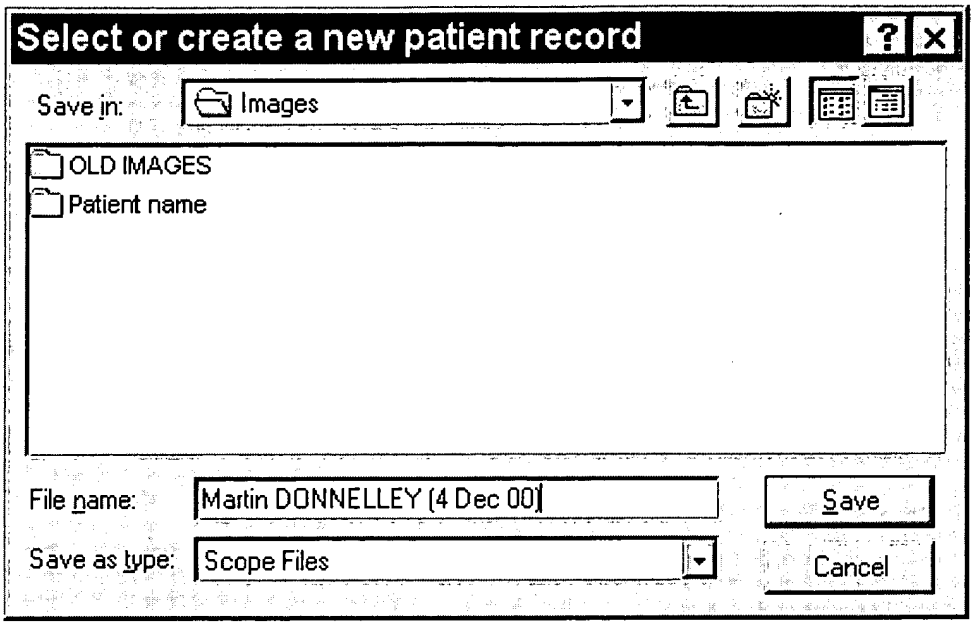
Select or create a new patient record
Save in:
Images
OLD IMAGES
Patient name
File name:
Martin DONNELLEY (4 Dec 00)
Save
Save as type:
Scope Files
Cancel

FIG. 34

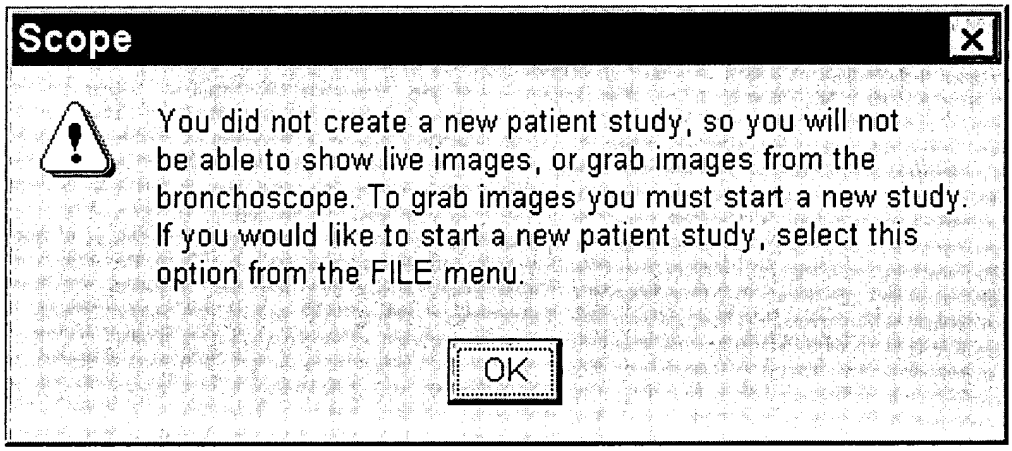
Scope
You did not create a new patient study, so you will not be able to show live images, or grab images from the bronchoscope. To grab images you must start a new study. If you would like to start a new patient study, select this option from the FILE menu.
OK

FIG. 35

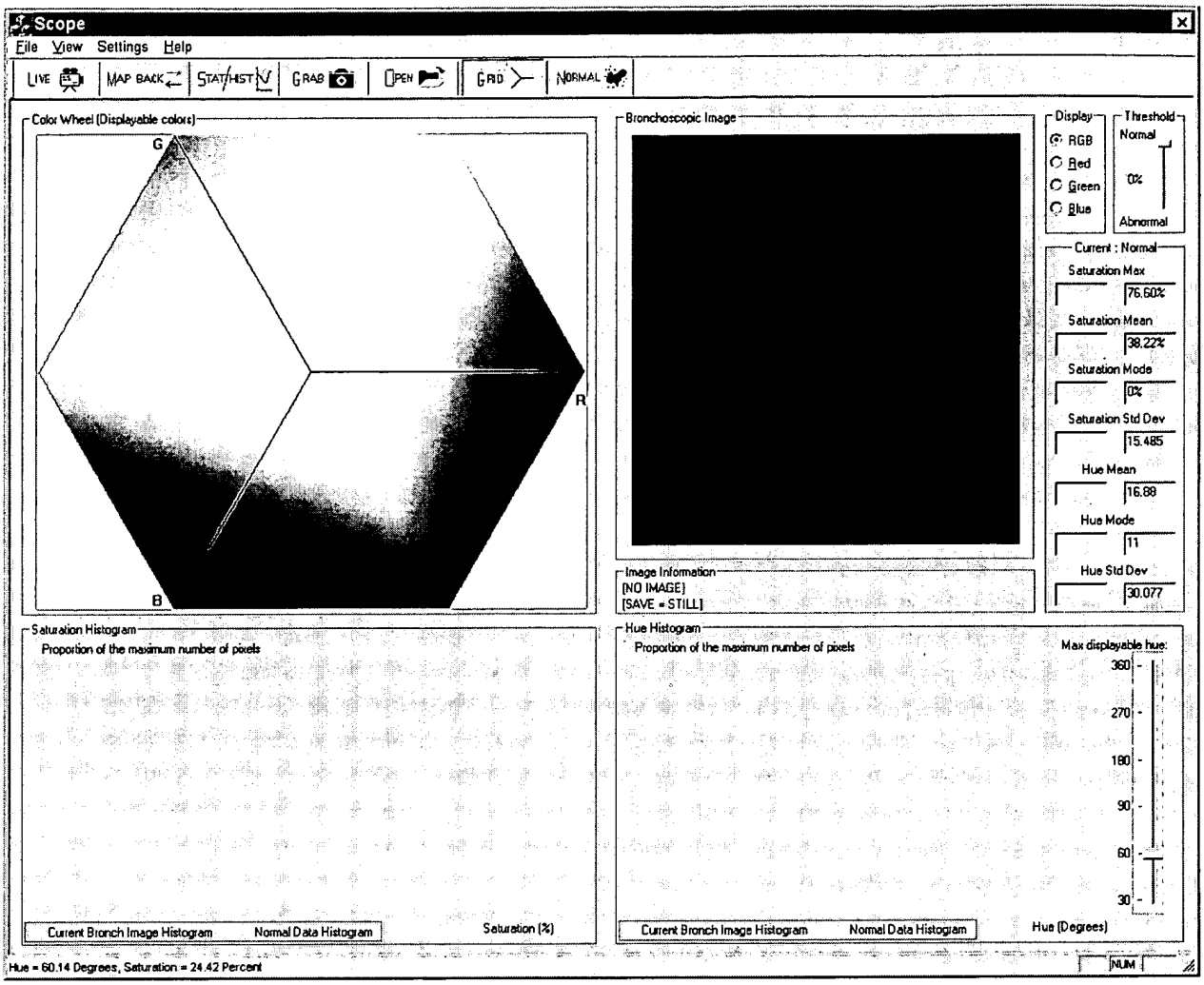
Scope
File View Settings Help
LIVE
MAP BACK
STAT/HIST
GRAB
OPEN
GRID
NORMAL
Color Wheel (Displayable colors)
G
R
B
Bronchoscopic Image
Display
RGB
Red
Green
Blue
Threshold
Normal
0%
Abnormal
Current : Normal
Saturation Max
76.60%
Saturation Mean
38.22%
Saturation Mode
0%
Saturation Std Dev
15.485
Hue Mean
16.88
Hue Mode
11
Hue Std Dev
30.077
Image Information
[NO IMAGE]
[SAVE = STILL]
Saturation Histogram
Proportion of the maximum number of pixels
Current Bronch Image Histogram
Normal Data Histogram
Saturation (%)
Hue Histogram
Proportion of the maximum number of pixels
Max displayable hue:
360
270
180
90
60
30
Current Bronch Image Histogram
Normal Data Histogram
Hue (Degrees)
Hue = 60.14 Degrees, Saturation = 24.42 Percent
NUM

FIG. 36

FIG. 37

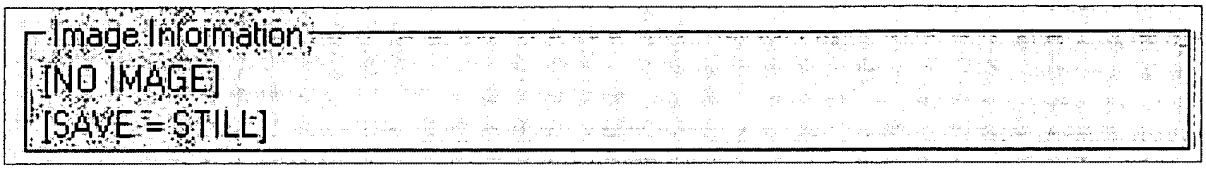

FIG. 38

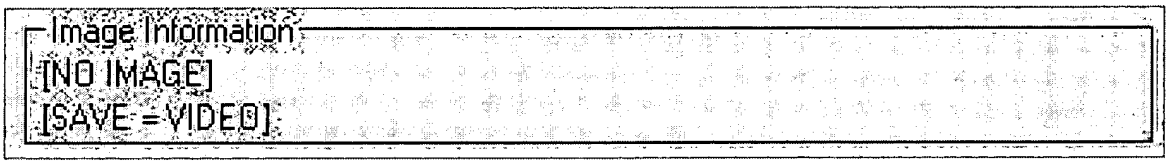

FIG. 39

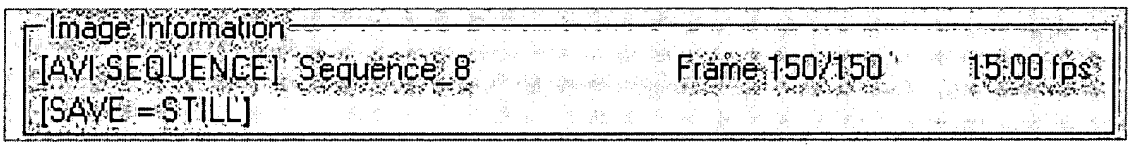

FIG. 40

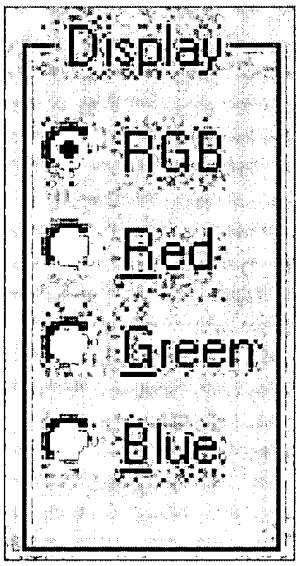

FIG. 41

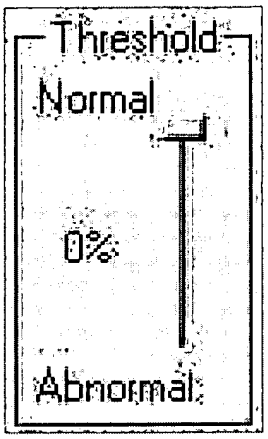

FIG. 42